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K. Alec Chrystal* and Monojit Chatterji**
Federal Reserve Bank of St. Louis
84-010

*Federal Reserve Bank of St. Louis and University of Sheffield
**University of Essex

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Abstract

In the last two decades the one macroeconomic concept which has become standard equipment in macroeconomics is the Natural Rate Hypothesis (NRH). The NRH is usually embodied as a vertical aggregate supply curve and forms a cornerstone of the "policy ineffectiveness" proposition. We emphasize that the driving power of the policy ineffectiveness proposition derives from the joint assumptions that (a) the aggregate supply curve is vertical and (b) that the aggregate supply curve is independent of aggregate demand.

We claim that this usage of the NRH is inappropriate for many purposes. It results from a trivialisation of the supply structure of the economy and has little justification if it is intended to analyze the real effects of virtually any imaginable policy. We give some examples where minor modifications to the supply structure generate an aggregate supply curve which is not independent of aggregate demand. With fully informed optimizing agents each policy action will generate a new general equilibrium. Nothing is "natural" and little is policy invariant. Evidence is presented to show that the issues raised may be of empirical significance.

In the last two decades the one macroeconomic concept which has become standard equipment in virtually all macroeconomic models is the Natural Rate Hypothesis (NRH). Many macro economists who see themselves as Keynesians have incorporated NRH into their models. For Monetarists it is the unique value towards which the real side of the economy converges in the long run. For New Classical economists NRH along with the Rational Expectations assumption is crucial not only for analytical purposes but also for the strong "policy ineffectiveness" claim.

The NRH is usually embodied as a vertical aggregate supply curve. This is viewed by most monetarists as a long run equilibrium position. New Classicisists on the other hand not only view the aggregate supply curve as being vertical in the long run but, up to a random term, also in the short run. This is because of the Rational Expectations assumption which in most models implies that systematic aggregate demand changes are fully anticipated and hence it is only genuine "surprises" which can make the short-run aggregate supply curve deviate from its long run vertical position. This is the basis of the "policy ineffectiveness" proposition. It should be noted that the driving power of the proposition that policy is ineffective (at least in the long run) derives from the joint assumptions that (a) the aggregate supply curve is vertical and (b) that the aggregate supply curve is independent of aggregate demand and hence of policies which can shift the aggregate demand curve. This in essence is the NRH in its most popular form.

Our claim is that this usage of the NRH is inappropriate for many purposes. It results from a trivialisation of the supply structure of the economy and has little justification in theory if it is intended to

analyze the real effects of virtually any imaginable policy. We shall give some simple examples in which minor modifications of supply structure generate an upward sloping aggregate supply curve and/or one which shifts in response to a potentially wide range of parameters and/or one in which aggregate supply is not independent of aggregate demand. We use a market clearing framework not because of any strong belief in short run market clearing but because we deliberately wish to choose a framework that is favorable to the NRH. It is of course obvious that there is a strong connection between market clearing and the NRH. Typically market clearing has been seen as necessary and sufficient for the NRH. The essence of our case is that whilst market clearing is necessary, it is not sufficient to establish NRH, except trivially.

We are aware that some of what we have to say is in the nature of an application of the Lucas (1976) critique to the Aggregate Supply function though our argument is stronger. Even with optimizing individuals who do not suffer from any money illusion and have full information about all relevant prices, each policy action will generate a different general equilibrium solution. Nothing is "natural" and little is policy invariant.

We should point out that other economists have already noted that the Natural Rate is the solution to a general equilibrium system. For example Buiter (1981b) and Grossman (1980) have argued, in passing, that changes in fiscal policy are likely to have real effects. However such arguments have had little impact on macro political economy. In any event the basis of this type of argument has not been given the focus and attention it deserves. The Natural Rate is still commonly viewed as a natural constant and is often the basis for a "hands off the system"

view. Our purpose here is to demonstrate in a simple but forceful way that (1) viewing the Natural Rate as a natural, unique constant is misleading for most purposes; and (2) that the recognition that the Natural Rate is a general equilibrium solution concept offers important insights into the nature of policy choices when the economy is in full equilibrium.

I.

The term "natural" rate was taken by Friedman (1968) from Wicksell who had applied it to the interest rate associated with equilibrium in asset markets. The "natural" rate of interest was determined by the real return on capital. Friedman applied it to unemployment.

> "The 'natural rate of unemployment'.... is the level that would be ground out by the Walrasian system of general equilibrium equations, provided there is imbedded in them the actual structural characteristics of the labor and commodity markets, including market imperfections, stochastic variability in demands and supplies, the cost of gathering information about job vacancies and labor availabilities, the cost of mobility, and so on." (op. cit. p.8)

In other words it is the unemployment that would prevail <u>in equilibrium</u> when all prices were fully adjusted, as if they had been set by a Walrasian auctioneer. There was no implication in this statement that the natural rate would be constant since it depended on 'structural characteristics' which may themselves change. These structural characteristics have generally been taken to be things affecting labor mobility and job search, such as unemployment benefit, and distortions, such as those caused by minimum wage laws. We argue that in reality, the range of 'structural characteristics' is large and includes most aspects of government policy. In fact our criticisms go further than this since

the whole idea of supply being independent of demand is inimical to a general equilibrium framework. Such a framework is most vehemently supported by exactly those New Classical economists who also use the NRH.

It should be made clear that our criticisms apply to the NRH in its aggregate supply curve form only. There are two interpretations of the quote from Friedman above to which we have no objections whatsoever. One of these is a theoretical proposition; the other we take to be an empirical generalization. The first is the homogeneity postulate. This is a totally desirable property of almost all economic systems which says that they should be homogeneous of degree zero in money and prices. This just means that all real allocations should be independent of accounting units and thus of the arbitrary choice of numeraire. The second interpretation is that questions about the value of money and questions about the level of activity are independent in the long run. This is a fairly harmless statement which no-one would find objectionable. It is, of course, the Quantity Theory of Money in its most acceptable form.

The homogeneity postulate tells us almost nothing of behavioral significance since virtually all classes of model will satisfy it. The Quantity Theory tells a little more. The value of money and the volume of money are, ceteris paribus, inversely related. On average changes in the money stock are correlated one to one with the price level but not at all with real output. Furthermore, there is no necessary causal link in the above statement. This may be interesting and important but it hardly tells us anything about the determinants of real activity and the influence of government policy upon that.

The way in which the natural rate hypothesis has been commonly adopted in macroeconomics is in fact much stronger than a statement about the neutrality of money. It is in the form of a stable vertical aggregate supply curve. With a stable vertical aggregate supply curve real output is independent of all systematic aggregate demand changes. The New Classical aggregate supply curve has now penetrated into standard text books. It has the following form.

$$(1) \qquad Y_t = \bar{Y} + \alpha(P_t - {}_{t-1}P^e_t)$$

Output, Y_t is equal to the 'natural' level, $\bar{Y}$, plus a function of the difference between actual inflation P_t and the inflation that was anticipated for period t in period t-1, ${}_{t-1}P^e_t$. This is the source of the strong New Classical claim that no anticipated aggregated demand change can have real effects since it will affect P_t and ${}_{t-1}P^e_t$ equally. We shall return to this issue below. First let us consider the determination of $\bar{Y}$ itself.

Consider the economy to be a single industry producing a single homogeneous output with a single variable input, labor. The firm hires workers up to the point where the real wage is equal to the real marginal product of labor. Workers supply labor up to the point where the real wage is equal to the marginal disutility (or cost) of effort. The labor demand curve depends on the real wage and the labor supply curve depends on the real wage. If an equilibrium exists it will be supported by a specific value of the real wage. If there is unemployment at that real wage it is only of a frictional nature. At the equilibrium real wage there is an associated value of output which will not change unless the real wage changes and the real wage will not change unless the structural

parameters of the economy change. This equilibrium value of output is the 'natural rate' of output.

Clearly, at least as a comparative static proposition, changes in the value of money will have no effect on this equilibrium, since money wages and prices will change equally and nothing real will be affected. Does it follow from this that demand policies can have no real effect? The standard answer is that policy can have some effect to the extent that it causes some distortions in the market mechanism. Unemployment benefits and minimum wage laws are well known examples. There is also distortionary taxes (Buiter 1981a). Unanticipated inflation (Lucas 1973) is also distortionary in this respect since actors misperceive prices and hence make the 'wrong' demand or supply decisions. Money may even have real effects of its rate of expansion affects the real interest rate and therefore influences capital formation (McCallum 1980). This would also be an artificial distortion to the real process of saving and investment.

The conception of macroeconomic policy as only working to the extent that it 'distorts' the mechanism is not accidental. It is, of course, at variance with the original conception which was as a corrective to market failure. Which view you take depends on whether you think the market works or not. The present paper does not offer evidence one way or another on issue. Rather we wish to purse further the limitations of the idea of a 'natural' level of output even within an equilibrium framework in which distortions are absent. We shall show that the one input/one output example is a rather special case. In more general cases the uniqueness of the natural level of output associated with the vertical and stable aggregate supply curve cannot be presumed.

Two different cases will be distinguished. The first is where there is more than one variable input and the economy is a price taker in one of its input markets. Here an increase in demand increases both output and employment. This illustrates the point that there may be some positive supply elasticity for a small open economy just as there is for a single firm the demand for whose output rises. This issue is thus posed as to the appropriate level of aggregation at which the natural rate should apply. If it is not true for a single firm which is a price taker in some input market why should it be true for the arbitrary collection of firms which make up a specific economy? The policy significance of this result depends upon whether governments can increase 'real' demand for domestic output.

The second case is where 'government' is considered to be a producer of goods which are an input to the firm. Here we show that the level of output is responsive to policy though the direction of response is ambiguous. Changes in policy reflect simultaneously decisions about demand and supply so that the aggregate supply curve cannot be independent of demand. In this respect most realistic macroeconomic policies are actually 'structural' in the sense of Friedman and will thus influence the 'natural' rates of both output and employment. We shall confine our attention to output. The extension to employment is straightforward.

II.

In this section we present an example of the supply curve which results from a simple extension of the one input one output framework

usually used in discussions of aggregate supply. Here we introduce a second input, materials, which are available at constant marginal cost. the appropriateness of this assumption will be discussed later. The analysis is similar to that applied to "input price shocks" by Bruno and Sachs (1982). However the implications of that study for the NRH and economic policy have not been fully appreciated.

The economy can be viewed as a single competitive firm (or the aggregate of a large number of identical such firms) producing a single homogeneous output X. Inputs are labor N and materials M. The money prices of these respectively are p,w and m. The production function is given by

$$X = N^{\alpha} M^{\beta} \qquad \alpha + \beta < 1. \tag{2}$$

It exhibits diminishing returns to scale. Let us first consider the input demand functions. Profit maximation requires that marginal physical product equals the real price for each factor:

$$M^{\beta} \alpha N^{\alpha-1} = \frac{w}{p} \tag{3a}$$

$$N^{\alpha} \beta M^{\beta-1} = \frac{m}{p} \tag{3b}$$

By substitution and taking natural logs this leads to the input demand functions

$$\ell n N_D = \theta_1 \ell n \left(\frac{w}{p}\right) + \theta_2 \ell n \left(\frac{m}{p}\right) + k \tag{4a}$$

$$\ell n M_D = \Pi_1 \ell n \left(\frac{w}{p}\right) + \Pi_2 \ell n \left(\frac{m}{p}\right) + k' \tag{4b}$$

where

$$\theta_1 = \frac{1-\beta}{\alpha+\beta-1} \qquad \theta_2 = \frac{\beta}{\alpha+\beta-1}$$

$$\Pi_1 = \frac{\alpha}{\alpha+\beta-1} \qquad \Pi_2 = \frac{1-\alpha}{\alpha+\beta-1}$$

$$k = \frac{\ell n \left[\alpha \left(\frac{\beta}{\alpha}\right)\right]^{\beta}}{(\alpha+\beta-1)} \qquad k' = \frac{\ell n \left[\beta \left(\frac{\beta}{\alpha}\right)\right]^{\beta}}{(\alpha+\beta-1)}$$

Also note that

$$\theta_1,\ \theta_2,\ \Pi_1,\ \Pi_2 < 0 \text{ and } \theta_1 + \theta_2 = \Pi_1 + \Pi_2 = \frac{1}{\alpha+\beta-1} < 0$$

So each input demand depends upon both relative prices. The input demand functions 4a and 4b are, of course, homogeneous of degree zero in prices.

Factor supplies are given by two conditions. First M is available at constant cost $\bar{m}$ which will be treated as a parameter of the model. Second, labor supply is of the classical form being dependent only on the real wage

$$(5) \qquad \ell n\, N_S = \lambda\, \ell n \left(\frac{w}{p}\right) \qquad \lambda > 0$$

labor market clearing implies $N^D = N^S$. We cannot determine $\frac{w}{p}$ and N uniquely because N_D also depends on $\frac{\bar{m}}{p}$. However, we can derive the aggregate supply curve treating $\bar{m}$ as parametric. From the production function.

$$(6) \qquad \ell n\, X_S = \alpha\, \ell n\, N + \beta\, \ell n\, M$$

Substituting from 4a and 4b yields

$$(7) \qquad \ell n\, X_S = \alpha\ \theta_1\ \ell n \left(\frac{w}{p}\right) + \alpha\ \theta_2\ \ell n \left(\frac{\bar{m}}{p}\right) + \alpha\, k$$

$$+ \beta\ \Pi_1\ \ell n \left(\frac{w}{p}\right) + \beta\ \Pi_2\ \ell n \left(\frac{\bar{m}}{p}\right) + \beta\, k'$$

this simplifies to

$$(8) \qquad \ell n\, X_S = a_1\, \ell n \left(\frac{w}{p}\right) + a_2\, \ell n \left(\frac{\bar{m}}{p}\right) + c \qquad a_1, a_2 < 0$$

where $a_1 = \alpha\theta_1 + \beta\Pi_1$, $a_2 = \alpha\,\theta_2 + \beta\,\Pi_2$ and $c = \alpha k + \beta k'$.

Equation (8) is not the supply curve since the real wage is endogenous. This is substituted out by setting labor demand, (4a), equal to labor supply (5). The solution for the equilibrium real wage is:

$$(9) \qquad \ell n \left(\frac{w}{p}\right) = \frac{\theta_2}{\lambda - \theta_1} \ell n \left(\frac{\bar{m}}{p}\right) + c'$$

where $c' = \frac{k}{\lambda - \theta_1}$

Substitute (9) into (8). This gives

$$(10) \qquad \ell n X_S = \phi \ell n \left(\frac{\bar{m}}{p}\right) + c''$$

where $\phi = \frac{a_1 \theta_2}{\lambda - \theta_1} + a_2$ and $c'' = a_1 c' + c$

The aggregate supply curve is then

$$(11) \qquad \ell n p = -\frac{1}{\phi} \ell n X_S + \ell n \bar{m} + c'''$$

where $c''' = \frac{c''}{\phi}$

of central interest is the sign of ϕ. By substitution we can show that

$$(12) \qquad \phi = \frac{\theta_2 + \lambda a_2}{\lambda - \theta_1}$$

As $\theta_1, \theta_2, a_2 < 0$ and $\lambda > 0$ this is unambiguously negative. Hence the supply curve (11) is positively sloped. The presence of $\ell n \bar{m}$ in (11) shows also that it will shift with each new value of material input prices. This is illustrated in Figure 1. It is easy to show that the classical vertical supply curve is restored if $\beta = 0$ or $\lambda = -1$. The first of these is the case where labor is the only variable input. The second requires the labor supply curve to be backward bending in a peculiar way.

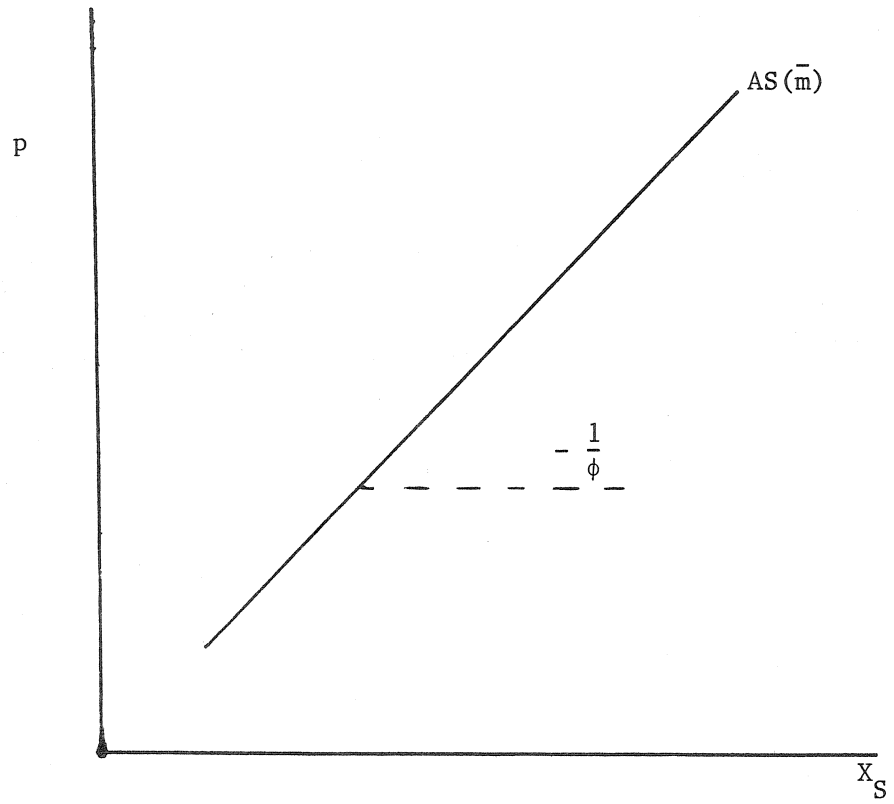

Figure 1

Recall that this is an equilibrium model and we have the classical labor market assumption. Yet we have derived our aggregate supply curve which is both non-vertical and will shift as material input prices change. It is obvious that there is no unique natural rate of output. The result clearly depends upon the existence of the other 'material' input whose price we take as given. How relevant is this? We would argue that it may be very relevant for some economies. A small open economy which is a price taker in the market for material inputs may be well represented by this case. A 'real' increase in demand for its output would then lead to more production and more employment at a higher real wage. Whether government could achieve such a real demand increase is, of course, another matter. Indeed the analysis suggests that traditional macroeconomic 'exogenous' variables will have differential effects. An increase in export demand will be expansionary. However, a money supply increase accompanied by proportional price rises will have no real effect as the equations (4) are homogeneous of degree zero in prices.

There are two different ways of looking at this result. First it illustrates that for an upward sloping aggregate supply curve stickiness of money wages is not necessary. Relative stickiness of any input price will do just as well. Secondly, and perhaps more importantly, if we hold $\frac{\bar{m}}{p}$ parametric instead of $\bar{m}$ it should be obvious that the aggregate supply curve becomes vertical but shifts with each value of $\frac{\bar{m}}{p}$. A natural interpretation of $\frac{\bar{m}}{p}$ is the terms of trade in the case where the material

input is imported. Letting $\bar{e} = \ell n \frac{\bar{m}}{p}$ be the terms of trade it follows from (10) that:

(10') $$\ell n X_S = \phi \bar{e} + c''$$

Thus there will be a different natural rate of output for each terms of trade. A deterioration in the terms of trade ($\bar{e}$ higher) lowers the natural rate of output. Therefore any policy which can influence the terms of trade will influence the natural level of output.

One interesting point suggested by this analysis is that the NRH is more likely to be true at the world level than at the level of an individual country. Obviously it is not normally true that the activity level of a single firm is independent of demand. Neither need it be true for any individual economy.

III.

Consider now a firm which produces its output by combining labor with a product or service provided free of charge by the government. The production function is

(13) $$X = N^{\alpha} G^{\beta} \qquad \alpha + \beta < 1$$

We ignore for the present government resource use but the extension to include a government production function is straightforward and we shall show the implications below. The level of provision of G is policy determined and is financed exactly by non-distortionary taxes. The firm chooses the optimal labor input given the level of G which it is provided. Set the marginal product of labor equal to the real wage. Converting into logs and rearranging as before gives

(14) $$\ell n\ N_D = b\ \ell n(\frac{w}{p}) - b\ \ell n[\alpha G^{\beta}]$$

where $b = \frac{1}{\alpha-1} < 0$

Using the same supply of labor as above in 4 and setting demand equal to supply gives

(15) $$\ell n\ (\frac{w}{p}) = \frac{b\ \ell n(\alpha G^{\beta})}{(b-\lambda)}$$

Substituting 15 into 5 gives

(16) $$\ell n\ N = \frac{\lambda b\ \ell n(\alpha G^{\beta})}{(b-\lambda)}$$

From the production function

$$\ell n\ X_S = \alpha \ell nN + \beta \ell nG$$

$$= \frac{\alpha\lambda b\ \ell n(\alpha G^{\beta})}{b-\lambda} + \beta \ell nG$$

So

(17) $$\ell n\ X_S = \delta \ell n\alpha + (\delta\beta + \beta)\ \ell nG$$

where $\delta = \frac{\alpha\lambda b}{b-\lambda} > 0$

As $\frac{\partial\ \ell nX}{\partial\ \ell nG} = \delta\beta + \beta$,

this is unambiguously positive since both δ and β are positive. So an increase in G raises output. The aggregate supply curve is vertical but it shifts for each level of G. In this simple case it is not surprising that a rise in G unambiguously raises output because G has a positive marginal product and no resource cost. Once G requires a labor input for its production the result becomes ambiguous. Suppose for example that the government production function is

(18) $$G = N^{\gamma}$$

Then the aggregate supply curve 17 becomes

(19) $$\ell n\, X_S = \delta \ell n \alpha + (\delta\beta + \beta - \mu)\, \ell n\, G$$

where $\mu = \frac{\alpha b}{(b-\lambda)\gamma} > 0$

The positive output effect of G is offset by a negative resource effect. Whether G shifts aggregate supply to the left or right now depends on whether the direct marginal product of labor in the output industry is greater than the indirect marginal product via G. As γ becomes small, government resource use is wasteful and μ becomes large. The denominator of μ reflects repercussions on labor supply via changes in the real wage.

The point we wish to make should now be clear. While in general the sign of $(\delta\beta + \beta - \mu)$ will be ambiguous there is no reason at all to expect it to be zero. We do have a vertical aggregate supply curve in this case but it is not associated with a unique natural level of output. The value of X will vary with each level of G. Once we incorporate G in the traditional way on the demand side it is clear that supply and demand are not independent. Notice however that the effect of G on X is entirely described by $(\delta\beta + \beta - \mu)$ in this case and does not depend at all on demand side multiplier type effects. Perhaps this should not be surprising in an equilibrium model, but it follows from the fact that the supply curve is vertical. In this respect we have found some support for the importance of 'supply side' effects. However these can clearly be positive as well as negative. The sign of the effect is an empirical question the answer to which will vary from case to case.

IV.

Most economists would accept the theoretical validity of the analysis presented above. Macroeconomists, however, would be likely to respond that its empirical relevance is small. These are microeconomic factors which can be ignored when considering aggregate output. We shall now present evidence which supports the view that, while some of these effects are offsetting, they are indeed 'real' and cannot safely be ignored even by macroeconomists. Furthermore when the different labour intensities of the different sectors are taken into account, it is highly unlikely that the effects will be offsetting as far as total employment is concerned.

The framework adopted is that popularized by Barro (1977, 1978). We investigated the determinants of output for the sectors of the U.S. economy classified by industry. Both the impacts of U.S. terms of trade and the level of government output production were considered. We found clearly determined effects in several sectors. However these tended to be offsetting so that aggregate effects on GNP or private sector output were only weakly determined.

The basic form of output equation tested was as in Barro (1981), but with the inclusion of a lagged dependent variable and terms of trade.

$$(20) \qquad Q_t = \alpha_1 \text{ CONST} + \alpha_2 Q_{t-1} + \alpha_3 DMR_t + \alpha_4 DMR_{t-1} + \alpha_5 G_t + \alpha_6 T + \alpha_7 TOT_{t-1}$$

where Q is the log of real output, T is a time trend, DMR is unanticipated money growth, G is the log of real federal purchases, and TOT is the U.S. terms of trade defined as the log of the ratio of U.S. export prices to U.S. import prices.[1/] The DMR series is the residuals from the following regression equation.

$$(21) \qquad DM_t = \underset{(2.4)}{.06} + \underset{(7.2)}{.67}\, DM_{t-1} + \underset{(3.6)}{.07}\, FEDV_t + \underset{(4.3)}{.04}\, U_{t-1} - \underset{(2.2)}{.02}\, U_{t-2} + DMR_t$$

$R^2 = .75$ D.W. = 1.97 Annual 1948-1982

where DM is the first difference of the log of the money stock, FEDV is abnormal real federal spending as defined by Barro (1977), and U is the log of the percentage unemployed. We offer no justification of this equation as it is similar to those used in Barro's work and almost identical to that used in Evans (1984). The inclusion of G_t in (20) is troublesome and will be discussed further below.

Table 1 presents the results of estimating equation 20 for GNP(Y), private sector output (PRI) which is GNP less output of government and government enterprises and overseas income, and private output broken down into 10 sectors. The money surprise variable is significant in all sectors except two--agriculture and mining. For the most part the impact is contemporaneous, though durable manufacturing has a lag effect as do services and transport and public utilities. The latter two may be indirect effects resulting from the time taken for durable manufacturing to respond rather than a direct (but delayed) response to money surprises.

The terms of trade has a clearly significant effect on output in three sectors--agriculture, non-durable manufacturing and wholesale trade. The first is negative and the latter two are positive. The positive sign is that predicted by (10') above, and is accordingly consistent with that model. Agriculture is different. It produces a non-differentiated product. Assuming the price of this product is fixed in world markets, a real appreciation of the dollar (terms of trade gain) reduces the output price relative to costs and this leads to an output reduction. The point to notice is that such terms of trade effects

should matter in theory and do matter in practice in some major sectors of the U.S. economy.

Our last comment on table 1 is that real federal spending is only significant in one sector (services) and there the impact is negative. From our argument above it should be clear that in an equilibrium supply framework there is no reason to expect a government spending variable to have real effects. Rather it is government output that should be used as in (17) and (19). There are two components to government output as measured in U.S. GNP statistics by industry, government itself and government enterprises. For present purposes we exclude output of government enterprises. Accordingly, government output was substituted for government spending in (20) and the results are reported in table 2.

Both GNP and private sector output are influenced positively by government output (GOV). The former is not surprising since GOV is a component of GNP, however, G was also a component according to the more traditional expenditure definition. The sectors which exhibit a positive response to GOV are mining and durable manufacturing. There is a strong negative effect in the service sector which indicates that there is clear 'crowding out' of this sector.

The discovery of mining and durable manufacturing as being positively related to GOV raised doubts about the generality of the specification of the model in (13)-(19) above. GOV was modelled as an input into other industries but in reality both are likely to be inputs into the other. Such a linkage could be modelled in an equilibrium framework, though it would be more complicated. Our point is merely that some such linkages do exist and should not be ignored.

Conclusion

While the notion of a 'Natural Rate' may be useful for some purposes, it has been taken too far. Its main use was as a pedagogic device to establish the point that 'real' issues and 'nominal' issues should not be confused. It has been used to establish much stronger claims about the nature of the 'real' outcome of the economy. We have demonstrated with two simple examples that, when the Natural Rate Hypothesis is taken to be synonymous with a vertical aggregate supply curve, incorrect conclusions will be drawn. The NRH in this form is clearly inconsistent with a general equilibrium approach to modelling the economy. The problem is that in this form the NRH takes the 'structure' of the economy as given. In full equilibrium models, all questions of interest are structural questions. Furthermore virtually every government policy is likely to have structural effects even if it was intended to serve merely as a stabilization device. Thus discussing the desirability of government spending purely in terms of the possibility of minimizing the variance of output around the (constant) natural rate is misleading.

Does this argument salvage anticipated stabilization policy? No it doesn't, because stabilization policy only makes sense in a disequilibrium setting. Can an expansion of government activity increase real income or welfare? Yes it can in some circumstances but these circumstances are not simply as a result of aggregate demand increases as in the traditional Keynesian model. Rather in an equilibrium framework government has to be viewed simultaneously as having demand and supply impacts. In general there will be an optimal level of provision of public services, just as there may be an optimal tax rate and indeed an

optimal tariff to influence terms of trade. To exceed the optimum is harmful. Contractions below the optimum will, however, also be harmful. Indeed our analysis suggests that the impacts of different kinds of government spending are likely to be different as they will probably have different structural effects. In other words an important area of debate is not just the level but also the type of government spending.

What we have said does not detract from the usefulness of the NRH for some purposes. Its impact on inflation theory was justified and important. It is also useful even in its aggregate supply curve form as a vehicle to isolate the effects of price level disturbances resulting perhaps from monetary shocks. What is absurd, however, is the implication often drawn that such disturbances are the only thing or even the main cause of all macroeconomic events. In many countries in the recent past, 'structural' disturbances such as those caused by the government itself and by oil price rises or oil discoveries have been much more important. The conventional natural rate framework is inappropriate for the study of these.

FOOTNOTES

1/ Note that this is the inverse of $\bar{e}$ as defined in (10') on page 12.

Table 1
Output of Sectors of U.S. Economy 1949-1982

DEP VAR	CONST	LAG DEP VAR	DMR_t	DMR_{t-1}	G_t	TIME	TOT_{t-1}	R^2	DW
Y	3.3	.43	1.1	.89	.03	.019	.055	.997	1.7
	(4.0)	(2.9)	(3.8)	(2.8)	(1.5)	(3.8)	(1.56)		
PRI	4.1	.28	1.1	1.0	.026	.025	.067	.997	1.74
	(4.6)	(1.8)	(3.4)	(2.8)	(1.1)	(4.5)	(1.66)		
AG	2.45	.3	-.32	-.65	-.01	.006	-.23	.94	1.8
	(4.0)	(1.8)	(.69)	(1.4)	(.37)	(3.8)	(3.5)		
FIR	.59	.87	.35	.08	-.005	.005	.004	.999	2.2
	(1.1)	(5.9)	(2.4)	(.58)	(.31)	(.83)	(.19)		
MIN	1.4	.27	.87	1.0	.07	.015	.032	.977	1.64
	(.35)	(1.7)	(1.6)	(1.85)	(1.8)	(4.3)	(.49)		
CON	.34	.84	1.7	-.45	.06	.0007	.14	.96	1.8
	(1.1)	(5.8)	(2.4)	(.65)	(.9)	(.2)	(.95)		
MANDUR	2.3	.36	2.7	2.8	.11	.019	.03	.97	1.8
	(3.9)	(2.4)	(2.9)	(2.9)	(1.5)	(3.8)	(.25)		
MANND	2.1	.43	1.3	.82	.005	.02	.17	.994	1.7
	(3.6)	(2.7)	(2.9)	(1.6)	(.01)	(3.5)	(2.9)		
RET	2.15	.48	.81	.59	-.03	.017	.06	.995	1.75
	(3.3)	(2.8)	(2.2)	(1.5)	(1.3)	(3.1)	(1.5)		
WHST	1.5	.52	1.3	.69	-.09	.022	.13	.997	1.8
	(3.3)	(3.6)	(3.6)	(1.6)	(.5)	(3.3)	(2.8)		
SERV	2.35	.43	.44	.63	-.035	.023	.026	.999	1.5
	(5.5)	(4.2)	(2.2)	(2.8)	(2.3)	(5.6)	(1.1)		
TPU	1.96	.46	1.31	1.43	-.01	.022	.02	.997	1.64
	(4.2)	(4.0)	(3.4)	(3.3)	(.4)	(4.7)	(.47)		

Note: See text for definition of independent variables in (20). Y=GNP; PRI=Private sector output; AG=Agriculture, forestry and fisheries; FIR=Finance, insurance and real estate; MIN=Mining; CON=Construction; MANDUR=Manufacturing durables; MANND=Manufacturing nondurables; RET=Retail Trade; WHST=Wholesale trade; SERV=Services; TPU=Transport and public utilities. All output variables are in natural logs. Absolute values of t-ratios are in parentheses. Data are annual.

Table 2

DEP VAR	CONST	LAG DEP VAR	DMR_t	DMR_{t-1}	GOV_t	TIME	TOT_{t-1}	R^2	DW
Y	3.7	.24	.97	.85	.23	.019	.017	.997	1.8
	(4.9)	(1.6)	(3.6)	(2.9)	(2.7)	(4.6)	(.48)		
PRI	4.2	.18	1.0	.98	.16	.024	.038	.997	1.84
	(4.9)	(1.1)	(3.2)	(2.8)	(2.0)	(4.8)	(.93)		
AG	2.9	.27	-.28	-.57	-.09	.009	-.22	.94	1.7
	(3.6)	(1.5)	(.6)	(1.2)	(.9)	(2.5)	(3.2)		
FIR	.59	.9	.39	.12	-.03	.005	.008	.999	2.2
	(1.6)	(7.8)	(2.7)	(.85)	(.9)	(1.0)	(.42)		
MIN	4.3	.18	.61	.81	.35	.008	-.03	.98	1.63
	(.85)	(1.2)	(1.2)	(1.5)	(2.8)	(2.1)	(.5)		
CON	-.06	.86	1.6	-.48	.14	-.003	.08	.96	1.83
	(.09)	(6.5)	(2.2)	(.66)	(.65)	(.72)	(.67)		
MANDUR	.9	.26	2.35	2.55	.54	.009	-.08	.97	1.86
	(1.1)	(1.66)	(2.6)	(2.7)	(2.2)	(1.5)	(.69)		
MANND	1.93	.38	1.25	.76	.097	.019	.15	.994	1.74
	(3.1)	(2.5)	(2.8)	(1.6)	(.91)	(3.4)	(2.6)		
RET	2.1	.5	.84	.54	-.04	.017	.069	.995	1.76
	(3.1)	(2.8)	(2.2)	(1.3)	(.48)	(3.0)	(1.4)		
WHST	1.29	.51	1.28	.59	.06	.021	.12	.998	1.9
	(2.6)	(3.5)	(3.5)	(1.4)	(.67)	(3.2)	(2.4)		
SERV	3.0	.39	.57	.79	-.16	.029	.06	.999	1.83
	(6.4)	(4.2)	(3.1)	(3.7)	(3.6)	(6.6)	(2.5)		
TPU	1.4	.49	1.23	1.21	.105	.018	-.0004	.997	1.8
	(2.6)	(4.7)	(3.3)	(2.9)	(1.3)	(3.6)	(.008)		

Note: See note to table 1. GOV=output of public sector excluding government enterprises.

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